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Cancer Institute Tiptoes About X-Ray Hazards

The National Cancer Institute, which normally trumpets any hint of advances in cancer treatment, has opted for silence in connection with three high-level advisory committees that found little merit and considerable hazard in a massive breast x-ray screening program conducted by NCI and the American Cancer Society (SGR Vol. VI, No. 16).

The committees, which were established by NCI in October 1975 to examine the benefits and risks of the NCI-ACS screening program, turned in their reports March 8, and they are available on request. But NCI, which routinely sends out carloads of unsolicited self-serving literature, has not included the reports in its regular mailings. Copies of the reports are prefaced by a long and obfuscating press release that deftly manages to conceal the message, namely, that thousands of women have been needlessly exposed to radiation hazard.

Congress Rushing Legislation On Recombinant Research—Page 4

Meanwhile, the ACS, which thrives on evoking hysteria about cancer, has rushed into a major public relations campaign to sell the virtues of x-ray mammography. In the March *Reader's Digest,* for example, Dr. Benjamin F. Byrd Jr., last's year's president of the ACS, offers the comforting advice that even if x-ray screening increases a woman's chances of getting cancer "in the distant future, there's also an excellent chance that by that time, science will have learned to control breast cancer."

Conceived by ACS in 1972, when funds from the National Cancer Act began to gush forth, the x-ray program was reluctantly supported by the Cancer Institute, and eventually drew in some 270,000 women, ages 35 and upwards, for what was planned as a 5-year program of annual screening. The program, deemed a "demonstration" project, was designed as a followup to smaller studies carried out through New York's Health Insurance Plan (HIP), which had demonstrated that routine screening, including mammography and physical examination, could indeed locate some asymptomatic cancers.

In the summer of 1976, however, critics of the HIP study and the NCI-ACS project publicly raised questions as to whether x-ray mammography might not, on balance, be more hazardous than healthful. Particular concern was raised about the advisability of screening women undere 50, since the incidence of breast cancer is relatively low in that group, and the hazards of radiation, though not known precisely, are nevertheless known to exist.

NCI responded to these criticisms by issuing interim guidelines that limited routine examinations to women over 50. The Cancer Society responded by issuing an "Urgent Message"—widely distributed to the press and the medical profession—in which it recommended x-ray screening of women under 50 if they met various criteria, among them being if "she has not borne children," and if "she began menstruating at 11 or under" — criteria which obviously rope in masses of women.

The studies which have now quietly emerged from

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In Brief

A lot of federal advisory committees are likely to get the axe as the result of a presidential directive for federal agencies to clean house. The White House has decreed that useless committees not created by statute are to be eliminated and that Congress should be asked to abolish statutory committees that have been idle. Criteria for keeping committees include "balanced" membership and compliance with "sunshine" rules.

While the Nuclear Regulatory Commission has shied away from providing financial support for "intervenors" in its proceedings, the Consumer Product Safety Commission is setting up procedures "for funding individuals and groups who want to participate in CPSC's rulemaking procedures." The Commission says its taking the step "because in some cases interested parties such as consumer groups did not have sufficient funds to present their position on an equal footing with industry."

NSF is setting up an experimental program to place scientists and engineers and science and engineering students in temporary jobs to advise the public on scientific and technical matters. Up to 25 professionals and 25 students will be selected on a competitive basis to work with local and state governments, labor unions, citizens organizations and so forth. The stipend for professionals is $18,000 for 12 months; for students, it's $5000. For further information: Office of Science and Society, NSF, 1800 G St. NW., Washington, DC 20550, (202)282-7770.

...Termination of Mass Screening Recommended

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NCI were carried out by three ad hoc working groups, chaired by Lester Breslow, dean of the School of Public Health, UCLA (epidemiology-biostatistics); Louis B. Thomas, chief of the laboratory of pathology, NCI (pathology), and Arthur C. Upton, Health Sciences Center, State University of New York, Stony Brook (radiation carcinogenesis).

In findings and recommendations that "represent the consensus of the members of all three groups," they state:

"Although the HIP data demonstrate that routine screening for breast cancer among women over age 50 yields benefit, it is difficult to assess the independent contribution of mammography" — a reference to the fact that in the HIP study, x-rays missed 44.7 per cent of cancers that were found by other means; also that many cancers that were detected by x-rays were detectable by other means.

The three groups added that "Since the HIP study showed no measurable benefit from routine mammographic screening of women under 50 years of age, and since there is some presumptive hazard from the radiation received, we recommend that mammography for routine screening of women under 50 years of age be discontinued."

Finally, in what adds up to a politely worded recommendation for termination of the NCI-ACS screening project, the groups jointly stated:

"Since HIP data contain suggestive but inconclusive evidence of benefit from including mammography in routine breast cancer screening of women over 50 years of age, and since no other available data seem pertinent to this issue, we recommend that further National Cancer Institute support of mammography in breast cancer screening of women over 50 now be concentrated on validating its use through appropriately designed randomized clinical trials."

In the odd nomenclature of the "demonstration" project, the call for "clinical trials" is significant, since the mass screening project has from the outset been carefully described as a non-research venture. This has given it considerable maneuvering room in regard to the rigorous informed consent requirements for projects involving human experimentation. Mainly for defensive purposes, the operators of the screening project have employed consent forms, but they contend they are doing so voluntarily and not in response to legal requirements. The project, they contend, is to demonstrate the application of the HIP findings, and therefore it does not come under the rules that govern research. An acknowledged shift to "clinical trials" would blow that cover.

Slow Pace in US-China Swaps

Now in their sixth year, scholarly and technical exchanges between the US and the People's Republic of China (PRC) are still confined to a modest number and remain on a tit-for-tat basis.

Though the US is constantly urging an expansion, the PRC, either openly or through bureaucratic foot dragging, keeps the pace of exchanges at more or less a constant level. Thus, in 1973, the first full year of formal exchanges, the Chinese sent seven delegations to the US and received four in exchange. With the Chinese ahead by three, the US opted for symmetry the next year, and each side sent and received five delegations. Since then, the annual exchanges have been evenly balanced, and have numbered between four and six.

The US exchanges are administered by the Committee on Scholarly Communications with the People's Republic of China, a consortium of learned societies based at the National Academy of Sciences.

The Chinese interest is mainly focused on scientific and industrial activities in the US. The Chinese are receptive to scientific and medical delegations from the US, but have turned down visits by social science groups.

The findings and recommendations of the study groups are now being examined at NIH. Meanwhile, the interim guidelines issued last year are still in effect. Final guidelines probably will not be issued until a new director is appointed for the Cancer Institute. Rumors about that selection continue to circulate, but there is no official word yet on the choice.

Back at the ACS, the Cancer Institute's quiet handling of the findings and recommendations is much appreciated. April is fund-raising month for the Cancer Society, and it really wouldn't do to let the public know that one of the Society's biggest ventures has been judged a dangerous botch.—DSG

NIH Seeks Cancer Institute Head

The National Institutes of Health has established a committee to select candidates for the post of Director of the National Cancer Institute, which has been vacant since the departure of Frank Rauscher last October for a $75,000 a year job with the American Cancer Society. Some 400 names have been submitted to the committee, and it is expected to draw up a shortlist for the Secretary of Health, Education, and Welfare at its next meeting, April 7.

NASA Chief Quits, NSF Post Still Undecided

With Frank Press finally nominated as President Carter's science adviser, the Office of Science and Technology Policy (OSTP), which he heads, is busy helping fill the many science posts still vacant in the federal government. Last month, it sent Carter several recommendations for the two major outstanding vacancies, Director of the National Science Foundation and Administrator of the National Aeronautics and Space Administration.

At NASA, Administrator James C. Fletcher, who has been in the job since April 1971, has announced that he will leave on May 1. Though Fletcher had made known his desire to stay on, he is said to have received an offer outside the government for which he had to make a speedy response. He asked the White House for an early decision on whether he would be kept at NASA, but when informed that the matter was still under review, he took himself out of the running and announced his resignation. It is likely to be at least a month before a successor is finally chosen and put through the elaborate clearance procedure now required for Presidential appointees.

At NSF, Richard Atkinson, who has been Acting Director since last fall, has also made known his desire to stay on in the top job at NSF, and the betting is that he will be kept.

Meanwhile, there were a number of changes last month in second-rank science posts. At the National Institutes of Health, Thomas Malone, formerly Associate Director of NIH for Extramural Research, has been promoted to Deputy NIH Director. Kenneth Chapman, who has headed the Nuclear Regulatory Commission's Office of Nuclear Material Safety and Safeguards for the past two years, has been appointed Assistant Administrator of NASA for Interagency Affairs. Robert Hirsch, of ERDA's Division of Solar and Advance Energy Systems, has resigned to return to private industry. And finally, Robert White has announced his resignation as Director of the National Oceanic and Atmospheric Administration (NOAA), effective July 15, to head the Climate Research Board of the National Academy of Sciences.

Press Hearing Set for April 7

The nomination of Frank Press as President Carter's science adviser and head of the White House Office of Science and Technology Policy (OSTP) was finally made official on March 18, when Carter sent the nomination to the Senate for confirmation.

A bit of confusion then ensued when the Senate leadership referred the matter to the wrong committee for action. But it was eventually referred correctly to the Committee on Commerce, Science and Technology, which was given exclusive authority over OSTP under the recent Senate reorganization. Confirmation hearings have been scheduled by the committee for April 7. No problems are anticipated.

One matter which is likely to concern Press during his first few weeks of office is a promise by Carter to restructure and slim down the White House staff. Carter has said that he wants to reduce the size of his Executive Office staff and reorganize it as a model of his oft-repeated pledges to streamline the Washington bureaucracy.

A study is now underway within the White House to seek ways to accomplish that goal, but the implications for the fledgling OSTP are not yet clear. "We could end up with more responsibilities and fewer staff or more staff and fewer responsibilities," one OSTP official told SGR. The review will take place through April and May, and Carter is expected to send a blueprint for a revamped White House to Congress in mid-June.

Some other comings and goings on the Washington R&D scene:

Unannounced, though reliably rumored, for assistant secretary of health in the Department of Health, Education, and Welfare: Christopher Columbus Fordham III, dean of the University of North Carolina Medical School. Not the first choice, but said to be a good

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Committees Rushing to Write DNA Regulations

Legislation to control recombinant DNA research throughout the United States, a prospect once feared by many genetics researchers, but which is now considered not only inevitable but welcome, began to crystallize last month. After a bit of a scramble to be first, three congressional committees scheduled hearings in as many weeks (with some individuals testifying at all of them), two major bills were introduced and the Carter Administration rushed to put together a bill of its own to be introduced in Congress early in April.

The scramble for priority in introducing legislation and calling hearings was led by Rep. Paul Rogers (D-Fla.), chairman of the subcommittee on health and environment of the House Commerce Committee. With Senator Kennedy's health subcommittee promising hearings in early April, the science, research and technology subcommittee of the House Science and Technology Committee planning oversight hearings in the last week of March, and the Administration getting a bill together, Rogers scooped everybody by introducing his own bill on March 9 and holding hearings on it within a week.

His bill, co-sponsored by several other subcommittee members, was thrown together in less than two days. Rogers announced that he wasn't wedded to the language in the bill and that it was designed chiefly to stimulate discussion. He then called hearings on March 15, 16, and 17.

In the meantime, a task force consisting of some 26 officials from 16 different federal agencies, chaired by NIH Director Donald Fredrickson, drafted a report to Secretary of HEW Joseph Califano, recommending that the Administration should draft legislation to control recombinant DNA experiments. The report also outlined the chief elements to be contained in such a bill.

Califano accepted the recommendation and announced that his department would move with dispatch in putting the task force's suggestions into formal legislation. Noting that legislation "would represent an unusual regulation of activities affecting basic science," Califano said, "I believe that such a measure is necessary not just to protect the public but also to assure the continuation of basic research in this vital scientific area."

With that, Kennedy issued a statement congratulating the task force and Califano on their work, noted a few "problem areas" in the task force's proposals and announced that his health subcommittee will hold a hearing on April 6.

Thus, the long, slow process of establishing controls on recombinant DNA experiments, which began in 1974

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Background Papers on DNA

The Library of Congress has put together a useful set of background papers and analyses of issues concerned with genetic engineering for the House subcommittee on science, research and technology, in preparation for the subcommittee's oversight hearings on recombinant DNA. The study, *Genetic Engineering, Human Genetics and Cell Biology,* is available without charge from the subcommittee, US House of Representatives, Washington, DC 20515.

APPOINTMENTS *(Continued From Page 3)*

choice, he succeeds Theodore Cooper, who has relocated to an office on the NIH campus, where, as a commissioned officer in the Public Health Service, he is available to consult with the new administration. Other candidates shied away from taking the post because HEW Secretary Califano insisted on reorganizing HEW prior to the appointment of a health chief.

The top research post in the Defense Department, director of defense research and engineering, has been filled by William J. Perry, president of ESL Inc., of Sunnyvale, Calif. The job was another one that was difficult to fill, for reasons of salary ($52,000, which is small stuff for high-technology industry), the uncertainties of pending reorganization, and the lumps incurred by the past incumbent, Malcolm Currie, who was publicly flayed for getting too cozy with defense contractors. Perry holds a Ph.D. in mathematics and spent 10 years with Sylvania Electric Products before founding ESL in 1974.

At the National Science Foundation, Alfred J. Eggers Jr., has submitted his resignation, effective June 30, as director of Research Applied to National Needs. In a letter to Acting Director Richard Atkinson, Eggers wrote, "I have become increasingly impressed with the magnitude and diversity of evidence that is accumulating to signal the constraints of nature on the growth and health of our society. Indeed, in the largest sense of our future activities with our natural resources in our environment, it may well be that in important respects we are entering a 'zero-sum-game.' " Eggers added that "in the near future I would like to come personally to grips with these issues . . ." 'He told SGR he hasn't specifically decided on what he'll do when he leaves NSF.

. . . Will National Rules Preclude Local Action?

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when a group of scientists went public with their concern that some types of experiments may pose potential health hazards, has finally reached Capitol Hill. Though it will take Congress several weeks, possibly months, before legislation emerges in final form, some of the chief elements of the legislation are already beginning to take shape.

First, it should be noted that Congress is unlikely to rewrite the guidelines issued last year by the National Institutes of Health. Both a draft bill based on the task force report, which was circulated by the Administration late last month, and the Rogers bill would require the Secretary of HEW to issue regulations based on the NIH guidelines, and Kennedy's statement indicated that he would also support that approach. Thus, with all three principal figures lined up behind that proposal, it is unlikely that a move to legislate radically new controls would be successful.

The bill is also expected to establish a licensing scheme under which either researchers themselves or the facilities they work in would have to be licensed by HEW before gene-splicing experiments are begun. And the legislation is expected to require HEW to monitor compliance with the regulations through inspections, report-keeping, and so on. The agency most likely to be given that oversight role is the Center for Disease Control, in Atlanta. Finally, it is generally agreed that the legislation would ensure that the regulations apply to all recombinant DNA research in the United States, whether it is supported by public or private funds.

Though there are differences of detail between the Administration's draft bill and the Rogers bill on those chief provisions, they are not expected to prove major stumbling blocks.

There is, however, one major area which is likely to provide difficulty—the extent to which federal controls will override those established by state and local governments. Many scientists who once fiercely resisted the notion of federal legislation now welcome it because they expect that federal legislation will pre-empt state laws and ensure that everybody is working under the same set of rules.

So far, only Cambridge, Mass., has adopted a set of regulations, but legislation is under consideration in the New York State legislature and in the California State assembly; New Jersey and Pennsylvania are considering holding hearings, and committees in a half-dozen cities have discussed whether recombinant DNA experiments in their local universities should be brought under some kind of city control. There is thus a possibility that a patchwork of local controls of varying strictness will be built up, a situation which wouldn't make much sense since any possible hazards associated with the research would not respect state or city boundaries.

The Administration's draft bill specifically states that federal regulations will pre-empt state and local controls, though the Secretary of HEW would be able to enter into agreements with state and local agencies to enforce the regulations. The Rogers bill, however, would allow states to set regulations which are at least as strict as the federal controls, leaving it up to the states to set harsher provisions if they want to. Kennedy noted that "we must carefully assess the wisdom of totally pre-empting state and local laws regulating the recombinant DNA research and applications, given our concern to assure involvement of the general public in these issues."

The issue is important. The entry of state and local committees into the recombinant DNA debate has provided a real chance for public input into policies for scientific research, an ideal often discussed but seldom put into practice. If Congress freezes local units out of the debate by pre-empting state and local controls, that move would be sure to raise stiff objections. It would, moreover, be politically difficult for a legislator to explain to the folks back home why he felt it necessary to keep them out of the business of setting safety standards for experiments conducted in their communities.

Congress will therefore have to try to balance the obvious need for uniform controls with the need to ensure public input into the debate. It may not be easy.—CN

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ERDA Picks Colorado Site for Solar Institute

Following a year of intense competition involving 19 organizations in 16 different states, the Energy Research and Development Administration has selected Golden, Colorado, as the home for the Solar Energy Research Institute (SERI), a facility which will be operated under contract to ERDA and which may eventually develop into the nation's solar research center.

The SERI contract has for long been the only major scientific project up for grabs, and it attracted considerable interest. Twenty organizations put in proposals, and ERDA officials selected all but one of them for further study. The winner is the Midwest Research Institute, a Kansas City, Mo., research organization which put in a bid in conjunction with the state of Colorado.

As a consolation prize for some of the unlucky contestants, ERDA also announced that it will establish three regional solar centers, which will operate in concert with SERI. Located in New England, the North Central region, and the Southeast, they will be run by a consortium of states and they will work on regional aspects of solar energy.

Asked specifically what the role of the regional centers would be, an ERDA official stated that "we have got to work that out." He said that the idea of establishing such centers was studied when the SERI proposal was first put forward, and that the concept was "revived from time to time." Though he acknowledged that the idea helped ease some of the political problems in choosing a single proposal for SERI from several competing states, "it wasn't a last minute flick decision." One of the regional centers will be based in Boston, and it will be operated by an organization consisting of representatives of all the New England states. The organization put in a proposal for SERI itself. The other two centers have yet to be chosen.

SERI itself will receive between $4 and $6 million in its first year of operation, rising to between $7 and $10 million next year, and $12-15 million in its third year. The initial staff will number about 75 professionals.

Though that is a modest undertaking in comparison with many federal contracts, there was stiff competition for the contract because of the possibility that SERI will eventually grow into a major research facility, bringing with it a lot of prestige and a large number of jobs.

To begin with, SERI will mostly carry out analyses and program planning for ERDA, but it will gradually take on some R&D work. After its third year of operation, according to ERDA officials, it may be moved to a permanent site (Midwest Research Institute has a 300-acre site available near Golden) and be given a substantial R&D budget. That, however, will depend on the overall size of ERDA's solar R&D budget.

NAS Urges Broader Authority for Environmental Agency

The Environmental Protection Agency (EPA) is hampered by conflicting environmental laws, lack of long-range scientific research on environmental problems, and some deficiencies in its decision-making processes. Those conclusions have emerged from a study by the National Academy of Sciences during the past three years.

The study, the results of which will be published in 11 volumes during the next few months, was mandated by Congress in 1973. Its genesis was a provision written into the appropriations bill for Agriculture, Environment and Consumer Protection, for the Academy to be given a $5-million contract to conduct a "complete and thorough review of the programs of the Environmental Protection Agency."

The provision was largely the work of Rep. Jamie Whitten (D-Miss.), chairman of the appropriations subcommittee which handled EPA's budget (it is now handled by the HUD and Independent Agencies subcommittee under the chairmanship of Rep. Edward Boland, of Massachusetts). Whitten was particularly upset by EPA's ban on DDT and believed that an objective study of its operations would turn up evidence of mismanagement and lack of attention to the social costs of environmental regulations.

The Academy, which rushed out an overview of the study last week to provide the new EPA director, Douglas Costle, with a timely report, didn't oblige Whitten by trampling all over EPA. In fact, the thrust of the report is that environmental protection cannot be provided adequately by the sort of piecemeal approach that Congress has adopted so far.

EPA is operating under a variety of laws that deal individually with air pollution, water pollution, toxic substances control, and so forth, rather than a comprehensive program dealing with all facets of the environment together. The report isn't explicit, however, on how Congress should go about revising legislation to establish a "comprehensive environmental management system," but presumably the recent committee realignment which has placed most responsibility for environmental programs in a single Senate committee will help.

The report also suggests that EPA should consider a different strategy for controlling pollution, one which relies on economic incentives rather than on the setting of rigid standards.

NIH Peer Review Gets High Marks from NIH

The peer review system of the National Institutes of Health has received a favorable report from a study committee of NIH executives. But they also suggested a few changes, including creation of an ombudsman's office for aggrieved grant applicants and the use of grant reviewers from profit-making organizations.

The study, carried out by a 14-member group chaired by Ruth L. Kirschstein, director of the National Institute of General Medical Sciences, is the latest of a long series of peer review inquiries inspired by Congressional sniping at the system and real concerns over whether peer review is working well.

The conclusion of the group, based on a 15-month inquiry that included questionnaires to all current reviewers and three one-day public hearings, is that it works well. As the group put it in a thick report accompanied by two thick appendixes of research materials, "The NIH grants peer review system is and has been extremely effective in identifying biomedical research activities of high quality."

Since that's more or less the conclusion of all peer review reviews, the few recommendations for important changes are all that matter.

In addition to the call for an ombudsman and reviewers from profit-making firms, these included the following recommendations:

- NIH should periodically announce all vacancies on the initial review groups that examine grant applications.
- So-called sunshine laws should not be extended to portions of meetings at which applications are reviewed.
- Following completion of a review of an application, the applicant should be given a summary of the conclusions and the priority score assigned to the proposed project.
- The workload of review groups should be reduced.

Another recommendation of more than routine interest called for a bit more sympathy for "unorthodox" research projects. The study group suggested that applicants should be required to "identify and support in detail the contention that the research project being proposed is especially innovative," and that reviewers identify applications they consider "especially creative or innovative." It was also recommended that "NIH consider the feasibility of developing an experiment involving limited support for certain speculative, high-risk innovative research programs."

The recommendations are under review by a study group set up by NIH Director Donald Fredrickson.

Federal Contracting-Out Policies Draw Senate Probe

Just behind the promises to uphold the Constitution come presidential promises to hold down the federal payroll. This could be harmless rhetorical stuff, but, in fact, the quest for the appearance of frugality leads to a variety of contortions in the personnel policies of federal agencies. Now, without attracting much notice, Senator Lee Metcalf (D-Mont.) has initiated a study that ought to dissolve the charade of government being anti-government.

The key to holding down the federal payroll is simply to contract for services that might be performed by government employees, whether or not it's cheaper or more efficient to get the work done that way. The practice is now so well established that the federal civilian payroll has remained essentially constant, at 2.8 million, for the past seven years, while federal budget authority has more than doubled in that period, from $213 billion to $433 billion.

In the recent Congressional tradition of legislating to ventilate the bureaucracy, Metcalf — author of the law that opened up federal advisory committees to public scrutiny — is collecting data on the contracting and consulting practices of all federal agencies. Working from the chairmanship of the subcommittee on reports, accounting, and management, he has sent questionnaires to all federal agencies, requesting detailed information on all outside services that they purchase. The first returns, covering seven agencies in the energy field, are now being tabulated with the assistance of the Congressional Research Service.

The question of who does what for the federal government is relatively easy to answer if you already know what you're looking for. But the overall picture of agency contracting is difficult to get at, and most agencies prefer to keep it that way. According to a staff member of the subcommittee, the Civil Service Commission reported that in 1975, federal agencies employed a total of 10,700 consultants. The subcommittee, after a brief survey, estimates that the true figure is approximately 60,000.

The subcommittee is planning to publish a directory listing all federal consultants; as for contractors, that's said to be considerably more complex and no decision has been made on how those details will be brought to public view.

In Quotes: NSF Chief on the Tenure Logjam

The following excerpts are from an address, "University Research and Graduate Education," delivered March 7 to the Western Association of Graduate Schools, by Richard C. Atkinson, Acting Director of the National Science Foundation:

Just as demography occupied the driver's seat during the expansive 1950s and 1960s, it seems certain to play a key role in the 1980s. The 18-year-old group in our population will peak at 4.3 million in 1979 and thereafter decline so that by 1990, it will number fewer than 3.5 million. . . This means, of course, that we can expect a decline in undergraduate enrollments commencing about 1980, followed four years later by a downward trend in graduate students. NSF presently projects a total of about 210,000 graduate students pursuing advanced degrees in the sciences and engineering in 1985, 15 per cent below the 1970 peak . . . . The Foundation projects a 7 per cent decline in science and engineering faculty between 1972 and 1985. Again, the worst case is the physical sciences, where we anticipate a drop of about 25 per cent.

We are critically concerned with how universities and faculties respond to this reduced demand. Frankly, the trends are not encouraging. We note a steady decline in the proportion of younger Ph.Ds on university faculties. In physics, for example, faculty members holding Ph.D degrees for seven years or less declined from 40 per cent to 19 per cent between 1968 and 1975. Simultaneously, there has been a substantial increase in the proportion of tenured faculty in the sciences and engineering, reaching an average of 70 per cent in 1974, with physics standing at 78 per cent and chemical engineering at 81 per cent. Finally, we note that tenured faculty is heavily concentrated in the middle years; between 1969 and 1973, for example, the median age of science and engineering faculty rose from 40 to 44 years.

Together, these trends threaten to lock out younger Ph.Ds from tenured faculty positions. In some disciplines, it is not an exaggeration to fear that we may lose an entire generation of bright, young minds. In the physical sciences, 80 per cent of the doctoral faculty in 1973 had not reached the age of 50, and 95 per cent were below the age of 60 . . .

To the extent it can be solved, initiatives will be required from the universities, in part because tenure, after all, is a private contractual relationship between universities and faculties.

Nevertheless, there are several areas where government assistance might play a role . . . . Thus, one might visualize the establishment of an incentive program to encourage mid-career shifts, in which the government contributed at least a portion of the funds necessary to maintain a retirement plan in effect, and only on condition that the vacated position is made available to a younger person.

A second possibility might be a program of Senior Research Scientist Grants for outstanding and productive scientists. The government might contribute half of the individual's salary, to a maximum of $25,000 annually, to permit the Senior Research Scientist to devote more time to research. Meantime, the university would use the released salary to appoint a young faculty member . . . .

A third idea . . . is the encouragement of joint university-industry research institutes which would be housed at the university and under university auspices. Industry might be encouraged to participate . . . through tax incentives as well as through expanded federal support for cooperative basic research projects conducted by teams of scientists drawn from both industry and the university.

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